PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04B 7/00 — A1

(11) International Publication Number: WO 96/27954

(43) International Publication Date: 12 September 1996 (12.09.96)

(21) International Application Number: PCT/US96/03187

(22) International Filing Date: 7 March 1996 (07.03.96)

(30) Priority Data:
112,926 — 7 March 1995 (07.03.95) — IL

(71) Applicant *(for all designated States except US)*: GEOTEK COMMUNICATIONS, INC. [US/US]; 20 Craig Road, Montvale, NJ 07645 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: EIN-DOR, Ido [IL/US]; 502 W. 122nd Street #33, New York, NY 10027 (US).

(74) Agent: NIXON, Larry, S.; Nixon & Vanderhye P.C., 8th floor, 1100 North Glebe Road, Arlington, VA 22201-4714 (US).

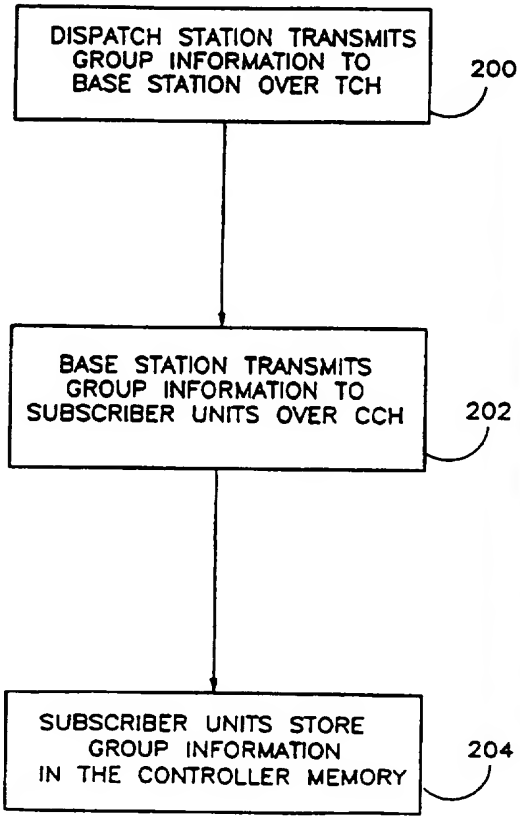
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A SUBSCRIBER UNIT FOR USE IN A MULTIPLE ACCESS COMMUNICATION SYSTEM

(57) Abstract

The invention discloses an apparatus and a method of controlling the scanning features of a mobile subscriber unit (6) used by a subscriber to a communication system, comprising the steps of storing a list of one or more groups (204) to which the subscriber belongs in the mobile subscriber unit, assigning a priority to each of the groups in the list, when a dispatch communication is received, determining the group to which the dispatch is directed and the priority level of the group, and if there is an existing dispatch communication being processed, comparing the priority level of the existing dispatch communication and the priority level of the recently received dispatch communication and enabling the reception of the dispatch communication with the highest priority level.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

A SUBSCRIBER UNIT FOR USE IN A MULTIPLE ACCESS COMMUNICATION SYSTEM

Background of the Invention

The present invention relates to wireless communication systems. More specifically, it relates to the subscriber units used in mobile wireless communication systems.

Current efforts in wireless communications, particularly in the segment of wireless communications referred to as Specialized Mobile Radio (SMR), have the goal of providing greater functionality to the SMR user, commonly known as a subscriber. These efforts have been limited by problems in the present SMR equipment. One equipment area where severe limitations exist is in the unit the subscriber uses to communicate, known as the subscriber unit.

The limitations include a problematic electronic architectural design that hinders the capabilities of the subscriber unit. As a result of this limitation, the subscriber units are unable to efficiently process the signals they communicate, including voice and data signals. Further, as a result of the problematic architecture, the subscriber units are unable to efficiently handle peripheral devices which may be necessary to efficiently process the communication signals received by the subscriber unit.

Current subscriber units are also limited in the features that they provide to their users, thereby causing inefficient use of communications resources. Many of these limitations exist in dispatch communication,

wherein businesses that have field employees -- employees working outside the office environment -- communicate with one or more of those employees at a time. One problem commonly encountered is that the field employees often must leave their vehicles (where the subscriber units are mounted) in order to perform their jobs and thus are not always able to hear the dispatched information on their radio terminals. If the field employee is away from the vehicle when a message is dispatched, the employee will miss the dispatched message. Depending on the importance of the message, this can lead to unfortunate results. This is but one example of the problems with current subscriber units -- there are many others.

In view of these and other limitations, systems and methods for more efficiently processing dispatched communications, therefore, are needed.

Summary of the Invention

In accordance with the present invention, a new subscriber unit architecture is utilized. The mobile subscriber unit of the present invention includes two pieces of equipment, a radio unit and a subscriber terminal. In accordance with a preferred embodiment of the present invention, the radio unit is housed in the trunk of an automobile while the subscriber terminal is housed in the passenger compartment of the automobile.

The radio unit includes a receiver, a transmitter, an input/output terminal, and processing means. The radio unit processor means processes the received and transmitted communication signals to provide communication services information through the radio unit input/output

terminal. The subscriber terminal includes an input/output terminal for communicating with the radio unit input/output terminal, a display for displaying information to the subscriber, a keypad through which the subscriber can enter information and processor means. The subscriber terminal processor means controls the display and the keypad. It also processes the communication services information supplied by the radio unit. It is also preferred to provide a second input/output terminal in the subscriber unit which is controlled by the processor means in the subscriber unit. Peripheral devices such as magnetic swipe devices, printers, bar code scanners and serial keyboards can be connected to this second input/output device and operated under the control of the subscriber unit processor means.

In accordance with another aspect of the present invention, dispatch information is transmitted over a wireless communication system and is processed in a subscriber unit. The subscriber unit stores all dispatch activity in a memory. Then, when requested by the user of the subscriber unit, the memory is accessed and a list of information related to the dispatch communications is displayed along with the time of occurrence for each dispatch communication. In accordance with a further aspect of the present invention, the dispatch information can be used to enable the user of the subscriber unit to call the entity that generated the dispatch communication. To call that entity, the user selects one of the displayed dispatch activities

by cursoring up and down the list and then selecting the appropriate key. The subscriber unit then causes a call to be made to the source of the selected dispatch communication.

As part of a dispatch scanning function performed by the subscriber unit, the subscriber unit stores a list of one or more groups to which the subscriber is assigned to and, when a dispatch communication is received, the subscriber unit determines the group to which the dispatch is directed and informs the subscriber of the group. In accordance with yet another aspect of the present invention, this dispatch scanning function is modified to perform priority scanning, scan nuisance delete and time scan disable.

In priority scanning, a priority level is assigned to each group and is stored by the subscriber unit in the list of assigned groups. Whenever a dispatch communication is received, the subscriber unit determines the group to which the dispatch is directed and then accesses the table of assigned groups and group priority levels. If there is an existing dispatch communication being processed when a new dispatch communication is received which is directed to one of the subscriber's groups, the subscriber unit compares the priority level of the existing dispatch communication and the priority level of the newly received dispatch communication and enables the reception of the dispatch communication with the highest priority level.

In scan nuisance delete, during times when there is excess and unwanted dispatch communication traffic to a group to which the subscriber

unit is assigned, the subscriber can select that group and delete it from the list which the subscriber unit maintains as part of the scanning function. The subscriber unit then does not scan for dispatches to that group, thereby eliminating the nuisance traffic.

In time scan disable, the subscriber can program the subscriber unit to stop scanning the list of groups to which the subscriber unit is assigned and then, after a selected period of time, enable the subscriber unit to automatically start the scanning process again.

The invention will now be described in connection with certain illustrated embodiments; however, it should be clear to those skilled in the art that various modifications, additions and subtractions can be made without departing from the spirit and scope of the claims.

Description of the Drawings

FIG. 1 illustrates a wireless communication system having a base station, a dispatch station and a plurality of subscriber units;

FIG. 2 illustrates the air interface utilized by the base station, the dispatch station and the subscriber units to communicate;

FIG. 3 shows a block diagram of the subscriber unit, including the radio unit and the subscriber terminal;

FIG. 4 illustrates an external view of the subscriber terminal;

FIG. 5 illustrates the circuitry of the subscriber terminal;

FIG. 6 illustrates the circuitry of the radio unit;

FIGS. 7 and 10 illustrate various screens shown on the display of the subscriber terminal during the dispatch mode;

FIG. 8 illustrates the distribution of dispatch group information to subscriber units;

FIG. 9 illustrates the steps taken by the subscriber unit upon reception of a dispatch and the steps taken to display the dispatch history;

FIG. 11 illustrates steps taken by the subscriber unit in implementing the last dispatch function;

FIG. 12 illustrates the steps taken by the subscriber unit to perform priority scanning;

FIG. 13 illustrates the steps taken by the subscriber unit to perform scan nuisance deletion; and

FIG. 14 illustrates the steps taken by the subscriber unit to perform time scan deletion.

Description of the Preferred Embodiment

Referring to FIG. 1, a communication system 1 is illustrated. The system 1 includes a base station 2, a dispatch station 4 and a plurality of subscriber units 6. The communication system 1 may be a frequency hopping system which is divided into sectors 8 to 10 wherein sets of frequencies are reused in each sector to provide wireless communications. Note, however, that the present invention may be used on other types of communication systems, including TDMA systems, CDMA systems and even

analog based systems.

The base station 2 includes the communication equipment necessary to provide the multiple access communications for the plurality of subscribers units 6 and for the dispatch station 4. The base station 2 also includes the communication equipment needed to provide communications through the Public Switched Telephone Network (PSTN).

The dispatch station 4 includes equipment necessary to dispatch communications from the dispatch station 4 to a number of subscriber units 6, commonly referred to as point-to-multipoint communications, and it also includes equipment that provides point-to-point communications. The subscriber units 6 generally consist of mobile or portable equipment necessary to transmit, receive and process communication signals.

Referring to FIG. 2, the communication links between the base station 2, the dispatch station 4 and the subscriber units 6 -- referred to as the common air interface -- are illustrated. The communication channels in FIG. 2 include a plurality of traffic channels (TCHs), at least one control channel (CCH) and at least one access channel (ACH). In the communication system 1 of FIG. 1, all of these channels are present in each sector 8 to 10. The TCHs operate in the uplink (transmissions from subscriber units 6 to the base station 2) and in the downlink (transmissions from the base station 2 to the subscriber units 6). The CCH and the ACH, however, operate only in one direction -- the CCH in the downlink and the ACH in the uplink.

In the illustrated embodiment of FIGS. 1 and 2, ten 25 kHz frequency channels are used to define ten uplink channels and ten 25 kHz frequency channels are used to define ten downlink channels. In each sector 8 to 10, nine of the frequency channels are used to implement nine uplink TCHs and nine of the frequency channels are used to implement nine downlink TCHs. In each sector, the remaining frequency channels are used to transmit one ACH and one CCH. Voice information, data information and inband overhead control signals between the base station 2 and the subscriber units 6 are transmitted over the TCHs, preferably using frequency hopping and time hopping communication methodology - - but any communication method and any air interface may be used. Timing and control signals from the base station 2 to the subscriber unit 6 are transmitted on the CCH. Status and operational requests from the subscriber unit 6 to the base station 2 are transmitted on the ACH. The common air interface of FIG. 2 is also used in communications between the base station 2 and the dispatch station 4.

Now that the communication system in which the subscriber unit 6 of the present invention operates has been described, the subscriber unit 6 will be described. Referring to FIG. 3, the subscriber unit 6 of the present invention is divided into two pieces of equipment, a radio unit 12 and a subscriber terminal 14. In general, the radio unit 12 transmits and receives communication signals to and from the base station 2, the dispatch station 4

or other subscriber units 6 through a pair of antennas 15 and 16 under the control of the subscriber terminal 14.

The radio unit 12, as will be seen in greater detail in later discussions and figures, provides the processing power needed to transmit and receive by performing essential communication processes. For example, the radio unit 12 performs the needed signal processing on transmit and receive signals, such as voice coding, error correction encoding, interleaving, Viterbi decoding, frequency hopping, time hopping, automatic gain control, automatic frequency modulation, diversity reception processing and modulation. The radio unit 12 also determines whether communications are voice communications, data communications or dispatch communications as well as various attributes concerning these communication type and uses this information to generate information about the communication services being provided. This list will vary from communication system to communication system, however, the architecture of the present invention requires that the processing necessary to the communication system being used be included in the radio unit 12.

The radio unit 12, therefore processes the received and transmitted communication signals to provide communication services information. This information is provided to the subscriber terminal 14 through the interfaces 17 and 18. The subscriber unit 14 provides a keypad and display interface to a subscriber and receives the communication services information from

the radio unit 12. The subscriber unit 14 also has a processor that controls the display and the keypad and also processes the communication services information provided by the radio unit 12.

The architecture of FIG. 3 is a client-server architecture wherein the subscriber terminal 14 is the client and the radio unit 12 is the server that serves the communication needs of the client the subscriber terminal 14. In the architecture of FIG. 3, the functions which provide an interface between communication services (voice transmit, voice receive, dispatch, data transfer, etc.) and the subscriber are performed by the subscriber terminal 14 while the functions which are necessary to interface to the communication system 1 to provide communication services are performed by the radio unit 12. Then when the subscriber requires the use of a communication service, the subscriber terminal 14 requests access to that service through the radio unit 12 and it is provided.

FIGS. 4 to 6 illustrate various aspects of the subscriber unit 6. In FIG. 4, an external view of a subscriber terminal 14, which is preferably positioned next to the subscriber in the passenger compartment of a vehicle, is illustrated. The subscriber terminal 14 includes a display 24, a keypad 26 and a handset 28. The keypad 26 includes five keys 30 to 34, commonly referred to as soft keys, whose function is defined by the features shown on the bottom of the display 24. The keypad 26 also includes a plurality of keys 36 to 43 having a variety of functions. Each of the keys 36 to 41 is

positioned next to a LED display 44 which is illuminated when the function associated with the key is enabled. The handset 28 includes a numeric keypad and the keys necessary to start and end a communication session. The handset 28 also has the traditional push-to-talk button found on many radio units.

In FIGS. 5 and 6, the processing circuitry of the subscriber terminal 14 and the radio unit 12, respectively, is illustrated. Referring to FIG. 5, the subscriber terminal 14 includes a microprocessor 50, an oscillator circuit 52, a power supply circuit 54, a serial interface circuit 56, a display driver circuit 58, a memory circuit 60, a keyboard interface circuit 62, an I/O decoder circuit 64, a LED driver 66 and an interface circuit 68. The subscriber terminal 14 can also include a real time clock 70, however, in a preferred embodiment, the base station 2 distributes real time clock information during its transmission to each of the subscriber units 6. In this preferred embodiment, the microprocessor 50 extracts the real time clock information from signals transmitted by the base station 2 and stores it in the memory circuit 60. This information is combined with timing information generated by the oscillator circuit 52 to provide the subscriber terminal 14 with real time clock information. If the base station 2 distributed real time clock information is utilized, then the real time clock 70, its back up power source, the battery 72 and the battery management circuit 72 and 74 in the power supply circuit 54, can be eliminated.

The memory circuit 60 includes a decoder circuit 76, an address latch 78, a boot ROM 80, a flash memory 82 and a static RAM 84. The boot ROM 80 stores the code necessary to initialize the microprocessor 50 and the circuitry of the subscriber terminal 14 as well as code necessary to download future software versions for the subscriber terminal 14. The flash memory 82 is non-volatile re-writable memory which is utilized to store information which must be maintained even during a loss of power. The static RAM 84 is utilized as a working memory as needed.

The display driver circuit 58 includes the LCD display 24, a power supply 86, a LCD controller 88, a memory circuit 90 and an address controller 92. The display driver circuit 58 is accessed by the microcontroller 50 via the I/O decoder 64. The information to be displayed is downloaded from the microprocessor 50 to the memory circuit 90. The display of the information on the display 24 is then controlled in a conventional manner by the LCD controller 88.

The microprocessor 50 is responsive to the selection of the keys 30 to 34 and 36 to 43, as well as to the selection of the keys on the handset 28. When the keys are selected, selection signals are processed through the keyboard interface circuit 62 to the microprocessor 50. The microprocessor 50 also controls the LEDs 44 through the LED driver circuit 66. The RS-232 interface 94 provides communications between the subscriber terminal 14 and external devices, such as notebook computers, magnetic swipe devices

used to read magnetic strips, printers, bar code readers and serial keyboards. The RS-485 interface 96 and the interface circuitry 68 provides communications between the subscriber terminal 14 and the receiver and transmitter circuitry of the radio unit 12 (shown in FIG. 6).

In FIG. 6, the circuitry of the radio unit 12 is illustrated. The radio unit 12 includes antennas 102 and 104, a radio board 106, a baseband unit 108, a service board 110, and a GPS interface 111. The radio unit circuitry illustrated in FIG. 6, except the antennas 102 and 104, in a preferred embodiment, is housed separately from the subscriber terminal 14, for example, inside the trunk of an automobile. The antennas 102 and 104 are preferably mounted externally on the automobile.

The radio board 106 includes transmitter and receiver circuitry. More particularly, it includes a transmitter 112, two receiver channels 114 and 116, a duplexer 118, a frequency synthesizer 120, gain and frequency control circuitry 122 and transmitter gain control circuitry 124. As previously describer, the circuitry of the radio board 106 provides communication via frequency hopping, that is, a communication signal is transmitted and received by hopping the signal over several different frequency channels.

The radio board 106 is interfaced with the baseband unit 108. The baseband unit 108 includes a modem 126, a controller 128, a voice processing package 130 and an interface circuit 132 to the subscriber

terminal's 14 circuitry. This baseband unit 108 receives the signals to be transmitted to the base station 2 from the subscriber terminal 14 and sends the signals to the transmitter 112 in the radio board 106 for transmission. This baseband unit 108 also receives the signals that the radio board 106 receives from the base station 2, performs some processing on the received signals and sends them to the subscriber terminal 14 through the interface 132.

The subscriber terminal 14 has several operational modes, one of which is the dispatch mode. When a subscriber selects the DISP KEY 41 on the subscriber terminal 14, the microprocessor 50 causes the subscriber terminal 14 to enter the dispatch mode, thereby allowing the subscriber to view information concerning the dispatch communications on the display 24. Upon entering the dispatch mode, the microprocessor 50 preferably causes the screen shown in FIG. 7 to be displayed on the display 24 . The screen preferably has at least seven sequentially numbered lines. The second line of the display 24 displays the word "DISPATCH", indicating that the subscriber terminal 14 is in the dispatch operational mode.

The subscriber unit 6 of the present invention allows subscribers to be divided into groups and, if desired, into subgroups as the dispatcher desires. For example, all subscribers that respond to the dispatch station 4 could be grouped according to their job function and subgrouped according to their regional responsibilities. In this example, if the dispatcher is communicating

with sales, service and delivery personnel, the dispatcher could assign all sales personnel to a first group, all service personnel to a second group and all delivery personnel in a third group. Then, calls which only concern sales personnel can be directed to the first group and so on.

Referring to FIG. 8, the process of distributing the group and subgroup information to the subscriber units 6 is illustrated. In step 200, the grouping and, if desired, the subgrouping desired by the dispatcher is transmitted from the dispatch station 4 to the base station 2 over a TCH. The base station 2 updates a subscriber database that it maintains and then, in step 202, transmits the group and subgroup information to all of the subscriber units 6 over a CCH. The group and subgroup transmitted by the base station 2 to the subscriber unit 6 are preferably stored in the radio unit 12 in memory in the controller 128 circuitry in step 204. It is possible for the subscriber to be assigned to multiple groups or multiple subgroups, in which case each of the assigned groups is stored in the controller 128. It is further preferred that the dispatcher 4 be able to modify the assigned groups and subgroups at any time by the method of FIG. 8. Whenever the grouping information is transmitted, the controller 128 will receive this transmitted information and store a new grouping and sub-grouping in its memory upon receipt.

When a subscriber belongs to more than one group, the subscriber can cause the subscriber terminal 14 and the radio unit 12 to enter the scan mode. The controller 128 in the radio unit 12 stores a list of the groups that

a subscriber is assigned to. When in the scan mode, the controller 128 compares the group that a dispatch communication is directed to with the groups in the controller's 128 list. If there is a match, then the controller enables reception of that dispatch. If the group that the dispatch is directed to is not on the controller's 128 list, then the controller 128 does not enable reception of the dispatch.

Information concerning the dispatch group and subgroup that a dispatch transmission is directed to is displayed on the third and sixth lines of the display 24 shown in FIG. 7. In FIG. 7, the "12a" (or just "12" if subgroup information is not being used) on the third line indicates the active group and subgroup of the subscriber unit 16. The "12" indicates the group and the "a" indicates the subgroup. The active group is the group which the subscriber can both hear and transmit to in the dispatch mode. The "3c" on the sixth line, just above the label LAST, indicates the last group and subgroup on which there was a dispatch call. The "5a" on the sixth line, just above the label PICK, indicates the group and subgroup to which an incoming dispatch is directed.

The items displayed on the seventh line of the display of FIG. 7 define the functions of the soft keys 30 to 34. In the dispatch mode, as shown in FIG. 7, the soft keys are defined as follows: the first soft key 30 (labeled "SCAN") implements the previously discussed scanning function, the second soft key 31 (labeled "PICK"), when selected, allows the subscriber to change

the active group as displayed on the third line of the display to the group displayed just above the PICK label (5a in FIG. 7), the third soft key 32 (labeled "1 TO 1") implements a function which is not relevant to this invention, the fourth soft key 33 (labeled "HIST") implements a dispatch communication processing function in accordance with one aspect of the present invention and the fifth soft key 34 (labeled "LAST") implements another dispatch communication processing function in accordance with another aspect of the present invention.

Before further describing the functions performed when the HIST and LAST soft keys are selected by the subscriber, some of the background processing performed by the subscriber terminal 14 and the radio unit 12 will be described. FIG. 9 illustrates some of the steps taken by the radio unit 12 and the subscriber terminal 14 each time a communication is received. In step 300, the radio terminal 12 determines whether the transmission is a dispatch communication. To allow the radio terminal 12 to perform step 300, the base station 2 adds control bits to transmitted communication signals on the CCH that match a predetermined sequence when the communication is a dispatch communication. The controller 128 processes each communication signal received by the radio unit 12 to determine the status of the control bits added to the communication signal by the base station 2. The controller 128 compares these control bits to the predetermined sequence which is stored in the controller 128 memory to

determine whether the received communication signal is a dispatch communication.

If the communication is not a dispatch communication, then the controller 128 exits the processing routine of FIG. 9 to perform other tasks on the receive communication signals. On the other hand, if the transmission is a dispatched communication, then, in step 302, the controller 128 accesses the control information in the communication signal to determine the group and subgroup (or groups and subgroups) that the dispatch communication is directed to. Then in step 304, the controller 128 accesses its memory to determine which groups and/or which subgroups the subscriber is allowed access to and compares this to the information contained in the dispatch communication. In essence the controller 128 determines whether the base station 2 has indicated that the subscriber belongs to the group.

If the subscriber is not permitted access to the dispatch, then the controller 128 exits this process to perform other tasks. If the subscriber is permitted access to the dispatch communication, then the controller 128 checks to see if the scan function is enabled or if the group is the active group. If either the scan function is enable or the group is the active group, the controller 128, in step 306, causes the dispatch communication signal to be sent from the radio unit 12 to the subscriber terminal 14. Otherwise, this process is exited.

In step 308, in the subscriber terminal 14, the microprocessor 50 scans the static RAM 84 which stores various information relating to the past dispatch communications received by the subscriber terminal 14 which have been directed to a group and/or a sub-group that the subscriber has been assigned to. The information stored includes the group and subgroup of the dispatch communication as well as the time of the dispatch communication. The microprocessor 50 determines whether there has been a dispatch communication directed to the same group as the present dispatch communication within a predetermined time period, preferably within the last minute. If the microprocessor 50 determines that there has been a dispatch communication directed to the group within the last minute, the microprocessor 50 exits this routine. If, however, there has been no dispatch sent to this group within the last minute, the microprocessor 50 continues to step 310 to process the dispatch communication. The purpose of step 308 is to prevent rapidly repeated dispatch communications within a group from being stored and displayed to the subscriber thus overwhelming the history function.

In step 310, the dispatch communication is time tagged by the microprocessor 50. The microprocessor 50 can time tag the dispatch either by accessing the real time clock 70 or by utilizing real time clock information that is distributed by the base station 10. After the time tagging, in step 312, the microprocessor 50 stores information associated with the dispatch

communication in the static RAM 84. The stored information includes the group, subgroups and the time tag associated with he dispatch communication.

In accordance with the present invention, the subscriber can access the stored information concerning dispatch communications by selecting the fourth soft key 33 which is labeled "HIST" in the dispatch operational mode. When the HIST key is selected and the subscriber terminal 14 is in the dispatch operational mode, the microprocessor 50 preferably causes the subscriber terminal 14 to implement a function whereby a history of information concerning or relating to the dispatch communications is displayed to the subscriber. When the HIST soft key 33 is selected, the microprocessor 50 causes the screen illustrated in FIG. 10 to be shown on the display 24. The second line of the display of FIG. 8, "DISP: CALL HISTORY", indicates that the subscriber terminal 14 is in the history mode. Then, on lines 4 to 6, information relating to the last three dispatch communications is displayed. The displayed information includes the group to which each dispatch communication was directed as well as the time that the dispatch communication was received. Also, the subgroup can be displayed. In a preferred embodiment, the subscriber can access the last ten dispatch communications that have information stored in memory by using the cursor up and cursor down keys 42 and 43 to cause the microprocessor 50 to display additional items from the lists of information that do not fit

onto the display 24.

The microprocessor 50 causes this information to be displayed by accessing the static RAM 84, retrieving the listing of stored information relating to past dispatch communications, including the associated group and time tags, and sending the information to the display 24 through the display driver circuit 58. Referring to FIG. 10, it can be seen that the subscriber can determine that the last dispatch communications received by the subscriber unit 16 were directed to a variety of groups at a variety of times. In particular, in this example, the display indicates to the subscriber that dispatch communications were sent to Group 3 at 11:14 a.m., to Group 9 at 10:58 a.m. and to the Sales Group at 9:12 a.m.

The arrows on line 4 of FIG. 10 indicate that the user of the radio terminal 22 can scroll up and down the displayed listing of dispatch information by using the keys 43 and 42, respectively. The subscriber terminal 14 of the present invention also enables the subscriber to make a call to the source of any of the dispatch communications. This is accomplished by scrolling to the line where information relating to the desired dispatch is displayed and then pressing a Push-to-Talk (PTT) button on the subscriber unit 16, which is located on the handset 28 of the radio terminal. The selection of the PTT button is recognized by the microprocessor 50 which then causes a main screen to be displayed as well as causing the transmission to occur, as described in the following. Upon

recognition of the selection of the PTT button, the microprocessor 50 determines which group the subscriber wishes to communicate with by accessing the memory 84 to see which listed dispatch communication the subscriber has selected. This information is passed to the radio unit 12 where the controller 128 formats a communication signal to be directed to the dispatch group which the subscriber selected. Communication signals are then sent by the transmitter 112.

In accordance with another aspect of the present invention, the subscriber can easily change the active group of the subscriber unit -- displayed on the third line of the display 24 -- to the last group -- the group that was just previously active on the subscriber terminal 14 which is displayed just above the LAST softkey -- by selecting the fifth soft key 34 which is labeled "LAST" while in the dispatch operational mode. The last group then becomes what was the active group. As an example, in FIG. 7, 12a is the active group and 3c is the last group. If a subscriber selects the LAST softkey, 3c becomes the active group and 12a becomes the last group.

Referring to FIG. 11, This function is accomplished in the subscriber terminal 14 by the microprocessor 50. The microprocessor 50 maintains the active group and the last group in memory 84. The microprocessor 50, in step 350, senses the selection of the LAST softkey and then, in step 352, causes the active group and the last active group stored in the memory 84

to be toggled. The microprocessor 50 also causes the groups shown in the display 24 to be toggled. This allows a subscriber to quickly respond to a dispatch communication from another group.

Referring to FIG. 11, steps 354 to 364 illustrate the other steps performed by the subscriber terminal 14 in implementing the last dispatch function. In step 354, the microprocessor 50 determines when a dispatch is received. When a dispatch is received, in step 356, the microprocessor 50 determines whether the PICK softkey is selected. If the PICK softkey is not selected, the microprocessor 50 causes the group to which the incoming dispatch was directed to become the last group, but the active group is not changed. As an example, if the active group was 9, the last group was 6 and the group to which the incoming dispatch was directed was 3, the last group would be changed to 3, but the active group would remain 9 if the PICK softkey is not selected.

If the PICK softkey is selected, then in step 360, the microprocessor 50 changes the active group to the group to which the incoming dispatch is directed and changes the last group to what was the active group. As an example, if the active group was 9, the last group was 6 and the group to which the incoming dispatch was directed was 3, then the last group would be changed to 9 and the active group would be changed to 3.

If a new group is manually selected by a subscriber using keys on the handset 28, the microprocessor 50 senses the selection in step 362. Then

in step 364, the microprocessor 50 causes the active group to be changed to the manually selected group and causes the last group to be changed to the previously active group. As an example, if the active group was 9, the last group was 6 and the manually selected group was 4, then the active group would be 4 and the last group would be 9. In an alternative embodiment, in step 364, the microprocessor 50 changes the active group to the manually selected group but does not change the last group. In the above example, the active group would again be changed to 4 but the last group would remain 6.

Referring now to FIG. 12, the steps performed by the controller 128 in the radio unit 12 to implement the priority scan function are illustrated. In step 400, the controller 128 determines whether a received signal is a dispatch communications. If it is not, the controller 128 performs other functions. If the received signal is a dispatch communication, then the controller 128 determines the group to which the dispatch communication is directed by accessing the control information associated with the communication.

Then in step 404, the controller 128 accesses its memory to determine whether the subscriber unit 6 belongs to the group to which the dispatch communication is directed. Recall that this information is transmitted by a dispatch station 4 through the base station 2 to the subscriber terminal 14. If the subscriber unit 6 finds that it does not belong

to the group, then the controller 128 goes on to perform other functions. On the other hand, if the subscriber unit 6 finds that it does belong to the group, then the controller 128 checks to see if the scan function is enabled. Then, if scan is enabled, in step 406, determines whether there is a prior dispatch communication being processed. If there is no prior dispatch communication being processed, then the controller 128 goes on to perform other functions, such as processing the current dispatch communication. If there is a prior dispatch communication being processed, then the controller 128 determines whether the subscriber has selected priority scan or not.

The subscriber selects priority scan from the subscriber terminal 14 by selecting the SETUP button 39 on the keypad 26. During the setup routine, the subscriber will be given the option of enabling or disabling priority scan. The subscriber terminal 14 transmits control signals to the radio unit 12 that indicate the status of priority scan which are stored in the memory of the radio unit 12. If priority scan is enabled, as part of the setup, the subscriber will be able to assign a priority level to each group to which he is assigned. Alternatively, the dispatcher can assign a priority level to the group and transmit that information with the group assignments to the base station 2 and ultimately to the subscriber units 6. In any event, the controller 128, in addition to storing the group assignments, stores the priority level of the group in its memory. In a preferred embodiment, there are two priority levels, high and low. In an alternate embodiment, there are a plurality of

priority levels which can be assigned to each of the groups.

Referring back to FIG. 12, if priority scan has been disabled, then after step 408 the controller 128 performs other tasks. If, however, priority scan has been enabled, then in step 410, the controller 128 accesses the priority level of the dispatch communication being processed and the priority level of the newly received dispatch communication. The controller 128 then compares these priority levels. If the priority level of the newly received dispatch communication is less than or equal to the priority level of the dispatch communication being processed, then the controller 128 goes on to perform other processing steps. If, however, the priority level of the newly received dispatch communication is greater than the priority level of the dispatch communication being processed, the controller 128 in step 412 causes the newly received dispatch communication to be received by the subscriber on the subscriber terminal 14.

Referring now to FIG. 13, the steps performed by the controller 128 in the radio unit 12 when implementing the scan nuisance delete function are illustrated. In step 440, the controller 128 determines whether the subscriber has enabled the scan nuisance delete function.

In a preferred embodiment, this function is enabled or disabled by the subscriber during the setup mode. As before, the subscriber enters the setup mode by selecting the SETUP button 39 on the keypad 26. During setup, the subscriber will be prompted to either enable or disable the scan

nuisance function. If the scan nuisance function is enabled, the subscriber will also be prompted to enter one or more groups which are to be deleted and to enter a length of time.

Referring back to FIG. 13, the subscriber terminal 14 transmits control information to the radio unit 12 that indicates whether the scan nuisance delete function is enabled or disabled and if enabled, which group or groups are to be deleted and a length of time the deletion shall be implemented. The controller 128 receives this information and, in step 442, determines which group or groups to delete from the scan list. In step 444, the controller 128 determines the length of time the group or groups shall be deleted from the scan list.

Next, in step 446, in a preferred embodiment, the controller 128 prompts the subscriber terminal 14 to ask the subscriber for a password that indicates that the subscriber is authorized to enable the scan nuisance delete function. If the subscriber enters an incorrect password, then the controller 128 proceeds to other processing steps. If the subscriber enters a correct password, then in step 448 the controller 128 causes the group or groups selected by the subscriber to be deleted from the scan list for the length of time selected by the subscriber. Then, in step 450, the controller 128, after the passage of the selected length of time, causes the deleted group or groups to be added back to the scan list.

In accordance with another preferred embodiment, the controller 128

checks the priority of each of the groups selected for temporary deletion. This priority can be set as previously described -- either by the subscriber or by the dispatcher at the dispatch station. When the scan nuisance delete function is enabled, the controller 128, before deleting any groups from the scan list, checks the priority of each of the groups selected for deletion. If the priority exceeds a predetermined threshold which is preferably set by the dispatcher at the dispatch station 4, then that group is not deleted from the scan list by the controller 128. Then the controller 128 sends a control signal to the subscriber terminal 14 to inform the subscriber that the group could not be deleted because of its priority level.

Referring to FIG. 14, the steps performed by the subscriber unit 6 to implement the time scan disable function are illustrated. In step 460, the controller 128 determines whether the time scan disable function is enabled or disabled. This function is preferably enabled or disabled by the subscriber in the setup mode, which is entered into by selecting the SETUP button 39. During the setup mode, if the time scan disable function is enabled, the subscriber can also enter a time which will be the time that the scanning function is disabled. This information is transmitted to the controller 128 so that the controller 128 can determine the length of time that the scanning function should be disabled for.

In accordance with a preferred embodiment of the present invention, if the subscriber attempts to enable the time scan disable function, the

subscriber terminal 14, in step 464 asks the subscriber for a password. The password is preferably set by the dispatcher from the dispatch station through transmissions through the base station 2. The subscriber then enters the password. If the password is incorrect, the microprocessor 50 in the subscriber terminal 14 determines that the subscriber is not authorized to enable the time scan disable function. If the password is correct, then the microprocessor 50 transmits the instruction to the controller 128 to stop the scanning function.

In step 466, the controller 128, when it receives the instruction from the microprocessor 50, stops scanning the previously described list of groups that the subscriber belongs to. Part of the instruction sent by the microprocessor 50 is the disabling time selected by the subscriber. The controller 128 keeps the scanning function disable for the selected length of time. Then, after the passage of the selected period of time, the controller 128 causes the scanning function to begin again.

It is understood that changes may be made in the above description without departing from the scope of the invention. It is accordingly intended that all matter contained in the above description and in the drawings be interpreted as illustrative rather than limiting.

WHAT IS CLAIMED IS:

1. A method of controlling the scanning features of a mobile subscriber unit used by a subscriber to a communication system, comprising the steps of:

storing a list of one or more groups to which the subscriber belongs in the mobile subscriber unit;

assigning a priority to each of the groups in the list;

when a dispatch communication is received, determining the group to which the dispatch is directed and the priority level of the group; and

if there is an existing dispatch communication being processed, comparing the priority level of the existing dispatch communication and the priority level of the recently received dispatch communication and enabling the reception of the dispatch communication with the highest priority level.

2. The method of claim 1, wherein there are two priority levels.

3. Apparatus for controlling the scanning features of a mobile subscriber unit used by a subscriber to a communication system, comprising:

means for storing a list of one or more groups to which the subscriber belongs in the mobile subscriber unit; and

means for deleting a selected one of the groups from the list.

4. The apparatus of claim 3, further comprising means for adding the deleted group back to the list after a predetermined length of time.

5. The apparatus of claim 3, further comprising:

means for assigning a priority to each of the groups in the list; and

means for checking the priority of the group selected to be deleted from the list and keeping the selected group on the list if the priority of the selected group exceeds a predetermined priority level.

6. The apparatus of claim 5, further comprising:

means for informing the subscriber that the group selected for deletion was a priority group that could not be deleted.

7. The apparatus of claim 3, further comprising:

means for asking the subscriber for a password before deleting the selected group; and

means for verifying the entered password and for enabling the deletion of the selected group only upon verification.

8. A method of controlling the scanning features of a mobile subscriber unit used by a subscriber to a communication system, comprising the steps of:

storing a list of one or more groups to which the subscriber belongs in

the mobile subscriber unit;

when a dispatch communication is received, determining the group to which the dispatch is directed and informing the subscriber of the group;

disabling the step of determining the group under control of the subscriber; and

after a selected period of time, enabling the step of determining the group.

9. The method of claim 8, further comprising the step of:

the subscriber entering the period of time in which the step of determining the group is disabled.

10. The method of claim 8, further comprising the steps of:

asking the subscriber for a password before disabling the step of determining the group; and

verifying the entered password and disabling the step of determining the group only upon verification.

11. A method of processing dispatch communications in a radio terminal, comprising the steps of:

storing information concerning the dispatch communications in a memory in the radio terminal; and

accessing the memory and displaying a listing of the information concerning the dispatch communications.

12. The method of claim 11, further comprising the steps of:

prior to the storing of information, receiving radio communications which include dispatch communications with the radio terminal; and

determining which communications are dispatch communications.

13. The method of claim 11, wherein the memory is accessed and the list of the information concerning the dispatch communications is displayed when a key on the radio terminal is activated.

14. The method of claim 11, further comprising the steps of:

selecting one of the displays of information concerning dispatch communications on the radio terminal; and

enabling a transmission from the radio terminal to the source of the selected dispatch communication.

15. The method of claim 14, wherein the selection of the dispatch communication is made by cursoring through the list of information concerning dispatch communications.

16. The method of claim 11, wherein the dispatch communications are grouped into a plurality of groups and the group associated with each dispatch communication is stored in memory.

17. The method of claim 16, wherein the display of information concerning dispatch communications includes the group to which the dispatch communication was made.

18. The method of claim 15, wherein the information concerning dispatch communications within one group is stored in the memory only once during a time period.

19. The method of claim 16, wherein the time period is one minute.

20. The method of claim 11, further comprising the steps of:

time stamping the dispatches as they are received;

storing the time; and

displaying the time of reception of each dispatch communication.

21. Apparatus for processing dispatch communications in a radio terminal, comprising:

means for storing information concerning the dispatch

communications in a memory in the radio terminal;

means for accessing the memory and displaying a listing of the information concerning the dispatch communications.

22. The apparatus of claim 21, further comprising:

means for receiving radio communications which include dispatch communications with the radio terminal; and

means for determining which communications are dispatch communications.

23. The apparatus of claim 21, further comprising a key that causes the memory to be accessed and the listing of the information concerning the dispatch communications to be displayed when activated.

24. The apparatus of claim 21, further comprising:

means for selecting one of the displays of information concerning dispatch communications on the radio terminal; and

means for enabling a transmission from the radio terminal to the source of the selected dispatch communication.

25. The apparatus of claim 24, further comprising means for cursoring through the list of information concerning dispatch communications to select

a dispatch communication.

26. The apparatus of claim 21, wherein the dispatch communications are grouped into a plurality of groups and the group associated with each dispatch communication is stored in memory.

27. The apparatus of claim 26, wherein the display of information concerning dispatch communications includes the group to which the dispatch communication was made.

28. The apparatus of claim 26, wherein the information concerning the dispatch communications within one group is stored in the memory only once during a time period.

29. The apparatus of claim 28, wherein the time period is one minute.

30. The apparatus of claim 21, further comprising:

means for time stamping the dispatch communications as they are received;

means for storing the time stamp; and

means for displaying the time of reception of each dispatch communication.

31. A method of processing dispatch communications in a subscriber's radio terminal wherein the subscriber is a member of one or more groups of subscribers, comprising the steps of:

storing the subscriber's current and previous active group in a memory; and

displaying the subscriber's current and last active group on a display of the radio terminal.

32. The method of claim 31, further comprising the step of:

switching the status of the active group of the subscriber radio terminal from the current active group to the previous active group.

33. Apparatus for processing dispatch communications in a subscriber's radio terminal wherein the subscriber is a member of one or more groups of subscribers, comprising:

means for storing the subscriber's current and previous active group in a memory; and

means for displaying the subscriber's current and last active group on a display of the radio terminal.

34. The apparatus of claim 33, further comprising:

means for switching the status of the active group of the subscriber

radio terminal from the current active group to the previous active group.

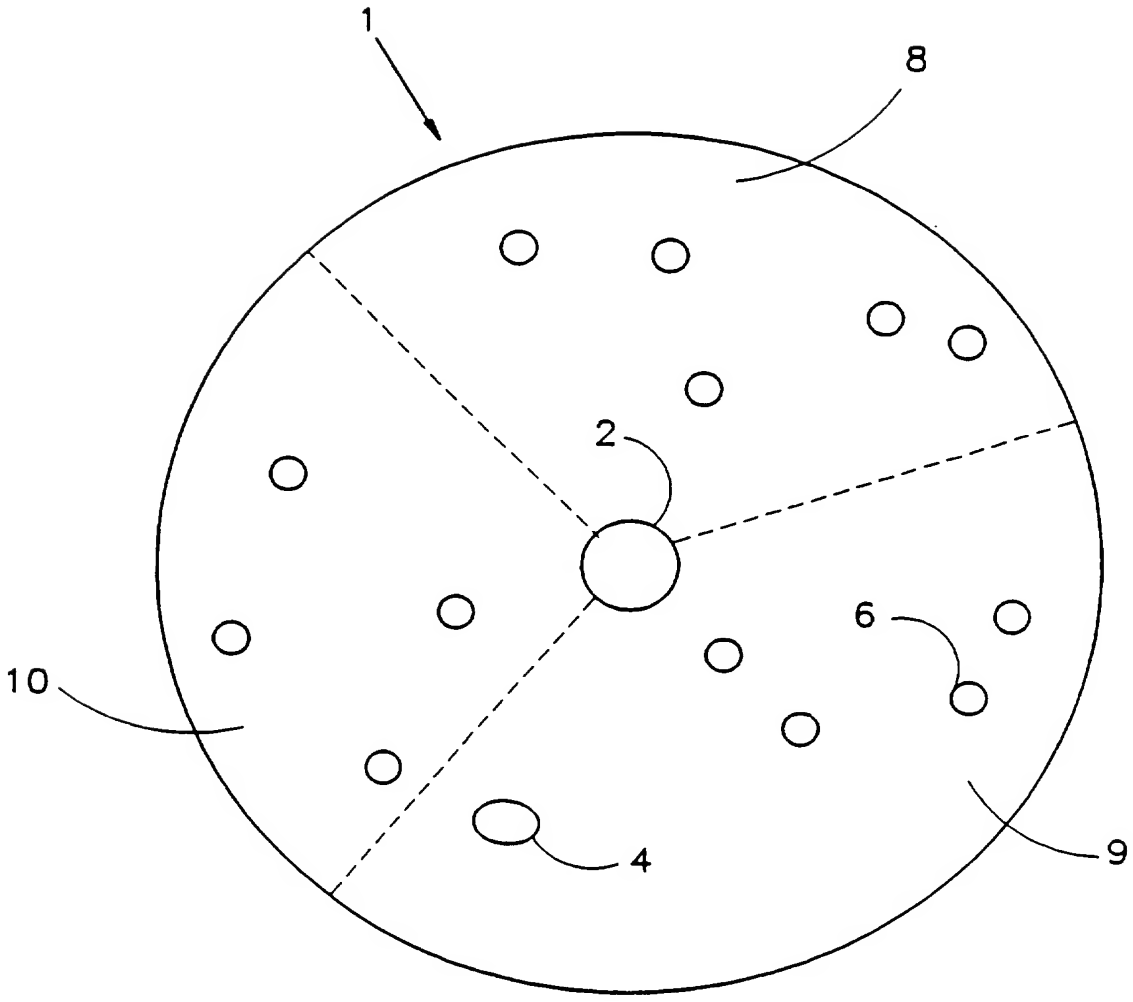


FIG. 1

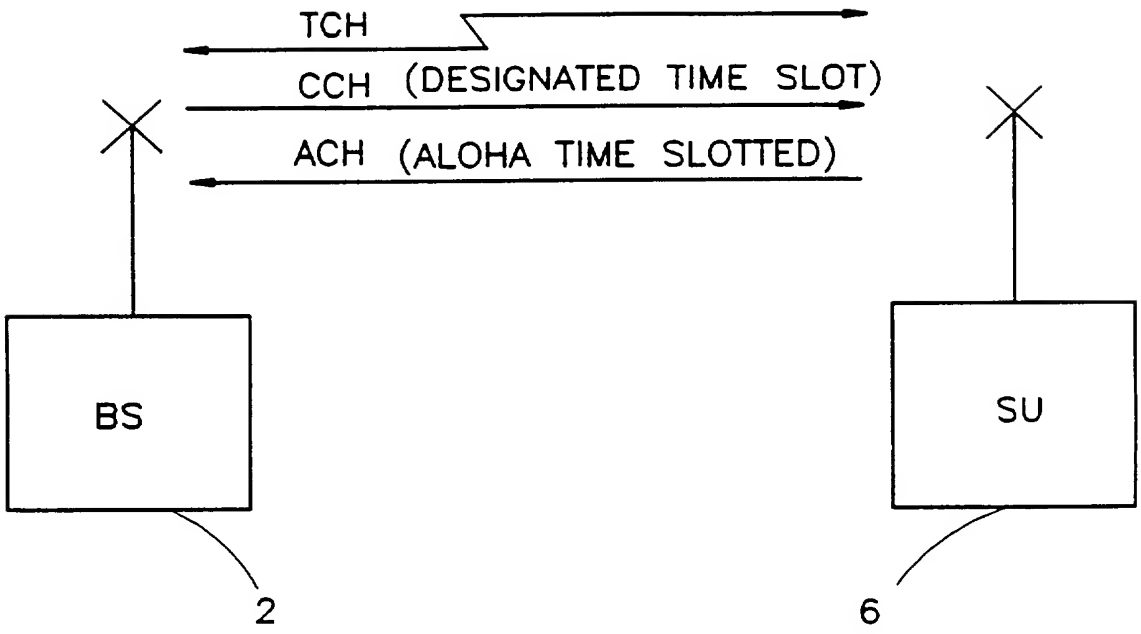


FIG. 2

FIG. 3

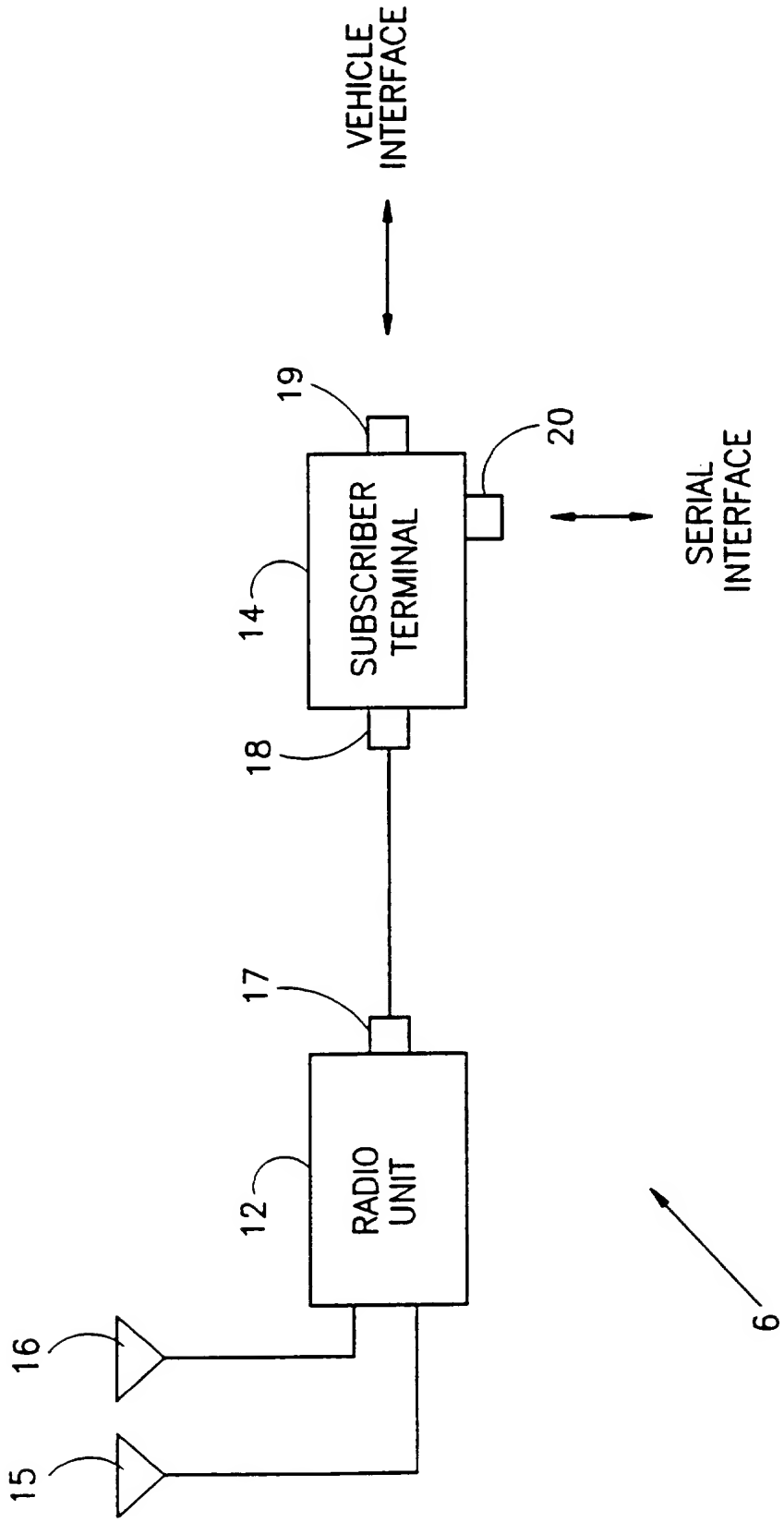
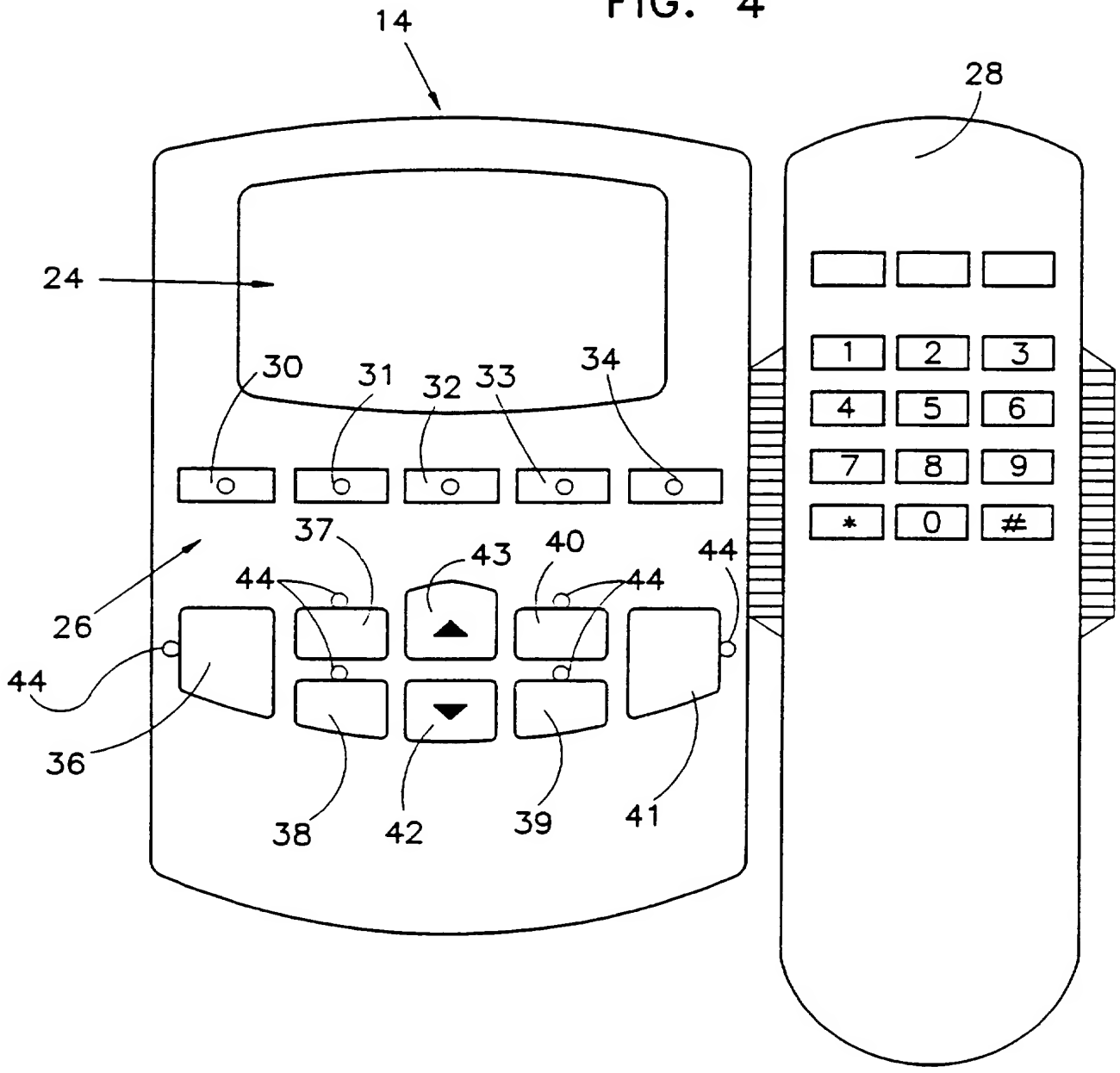

VEHICLE INTERFACE
19
20
SERIAL INTERFACE
SUBSCRIBER TERMINAL
14
18
17
RADIO UNIT
12
16
15
6

FIG. 4


14
28
24
30
31
32
33
34
1
2
3
4
5
6
7
8
9
*
0
#
37
43
40
44
44
44
26
44
36
38
42
39
41

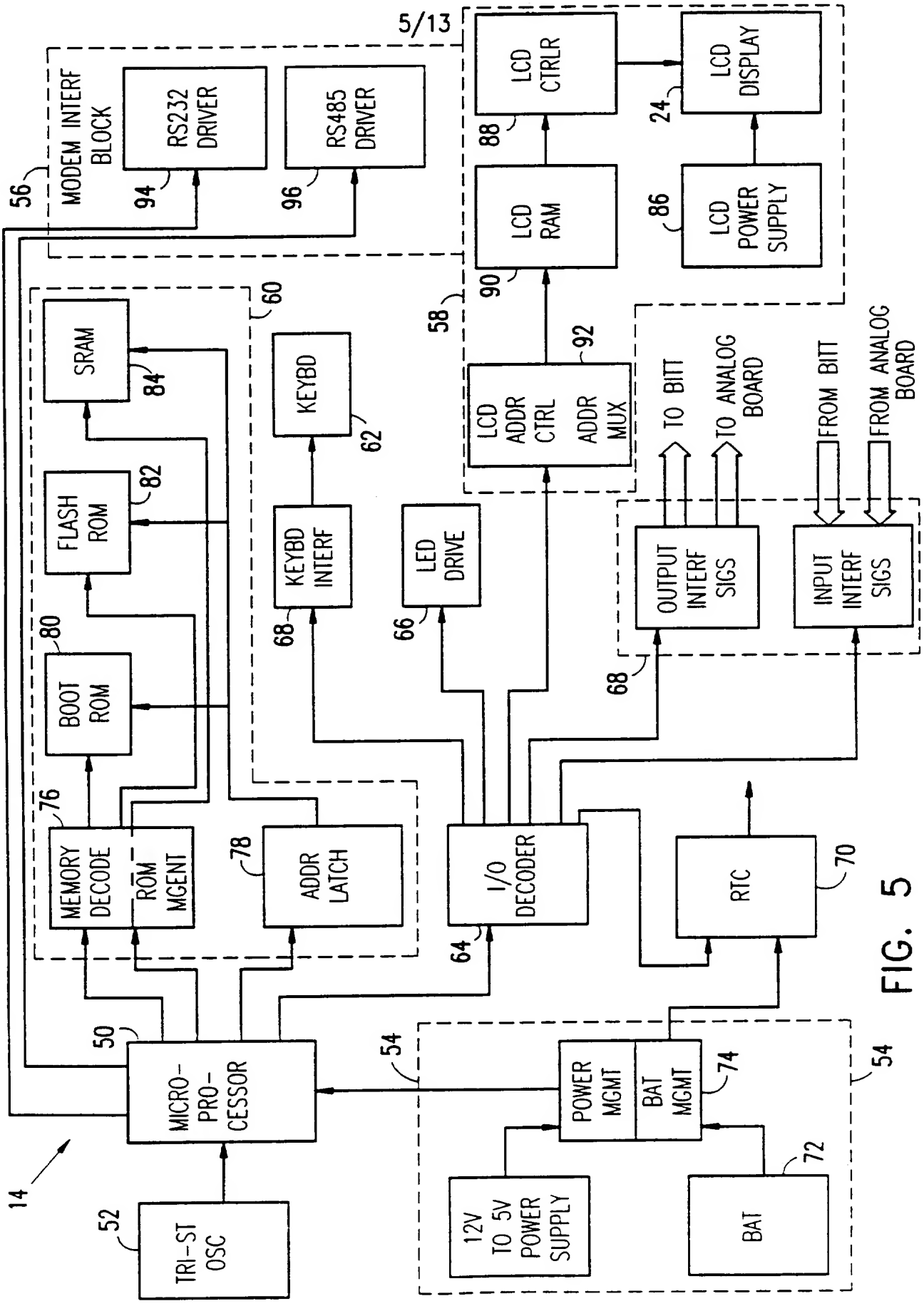

MODEM INTERF BLOCK
56
RS232 DRIVER
94
RS485 DRIVER
96
LCD CTRLR
88
LCD DISPLAY
24
LCD RAM
90
LCD POWER SUPPLY
86
58
60
SRAM
84
KEYBD
62
LCD ADDR CTRL
ADDR MUX
92
TO BITT
TO ANALOG BOARD
FROM BITT
FROM ANALOG BOARD
FLASH ROM
82
KEYBD INTERF
68
LED DRIVE
66
OUTPUT INTERF SIGS
INPUT INTERF SIGS
68
80
BOOT ROM
76
MEMORY DECODE
ROM MGENT
78
ADDR LATCH
I/O DECODER
64
RTC
70
50
MICRO-PRO-CESSOR
54
POWER MGMT
BAT MGMT
74
54
14
52
TRI-ST OSC
12V TO 5V POWER SUPPLY
BAT
72

FIG. 5

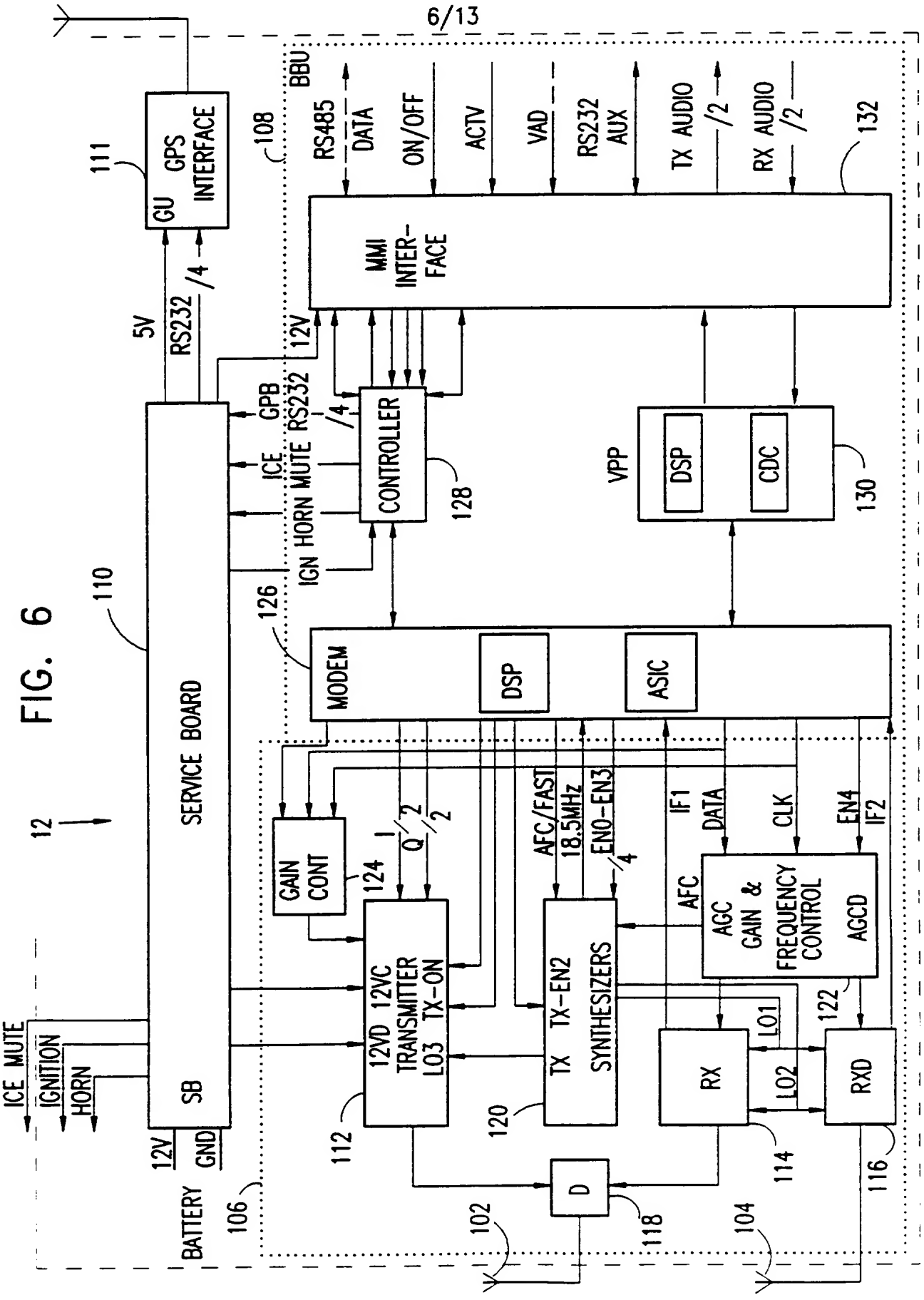

BBU
RS485 DATA
ON/OFF
ACTV
VAD
RS232 AUX
TX AUDIO /2
RX AUDIO /2
132
MMI INTER-FACE
GU GPS INTERFACE
111
108
5V
RS232 /4
12V
GPB /4
RS232
ICE
MUTE
HORN
IGN
CONTROLLER
128
VPP
DSP
CDC
130
110
SERVICE BOARD
126
MODEM
DSP
ASIC
12
GAIN CONT
124
I
Q
/2
/2
AFC/FAST
18.5MHz
EN0-EN3
/4
IF1 DATA
CLK
EN4 IF2
AFC
AGC GAIN & FREQUENCY CONTROL
AGCD
122
12VD 12VC TRANSMITTER LO3 TX-ON
TX TX-EN2 SYNTHESIZERS
RX
LO1
LO2
RXD
112
120
114
116
ICE MUTE
IGNITION
HORN
SB
12V
GND
BATTERY
106
D
118
102
104

FIG. 6

FIG. 7

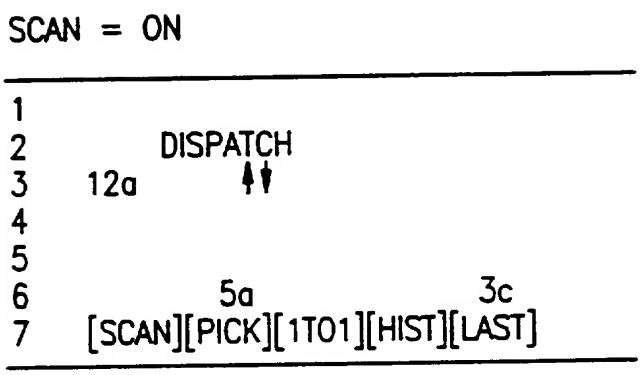

SCAN = ON
DISPATCH
12a
5a
3c
[SCAN][PICK][1TO1][HIST][LAST]

FIG. 10

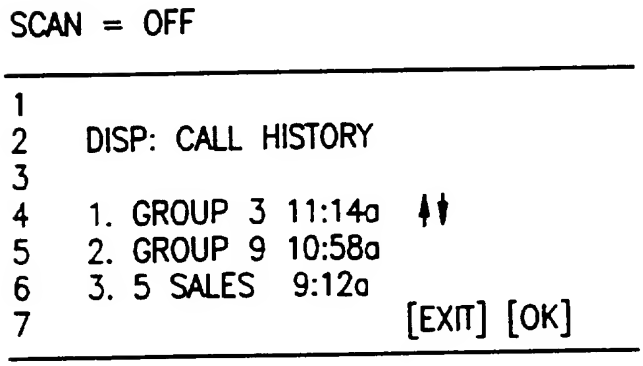

SCAN = OFF
DISP: CALL HISTORY
1. GROUP 3 11:14a
2. GROUP 9 10:58a
3. 5 SALES 9:12a
[EXIT] [OK]

FIG. 8

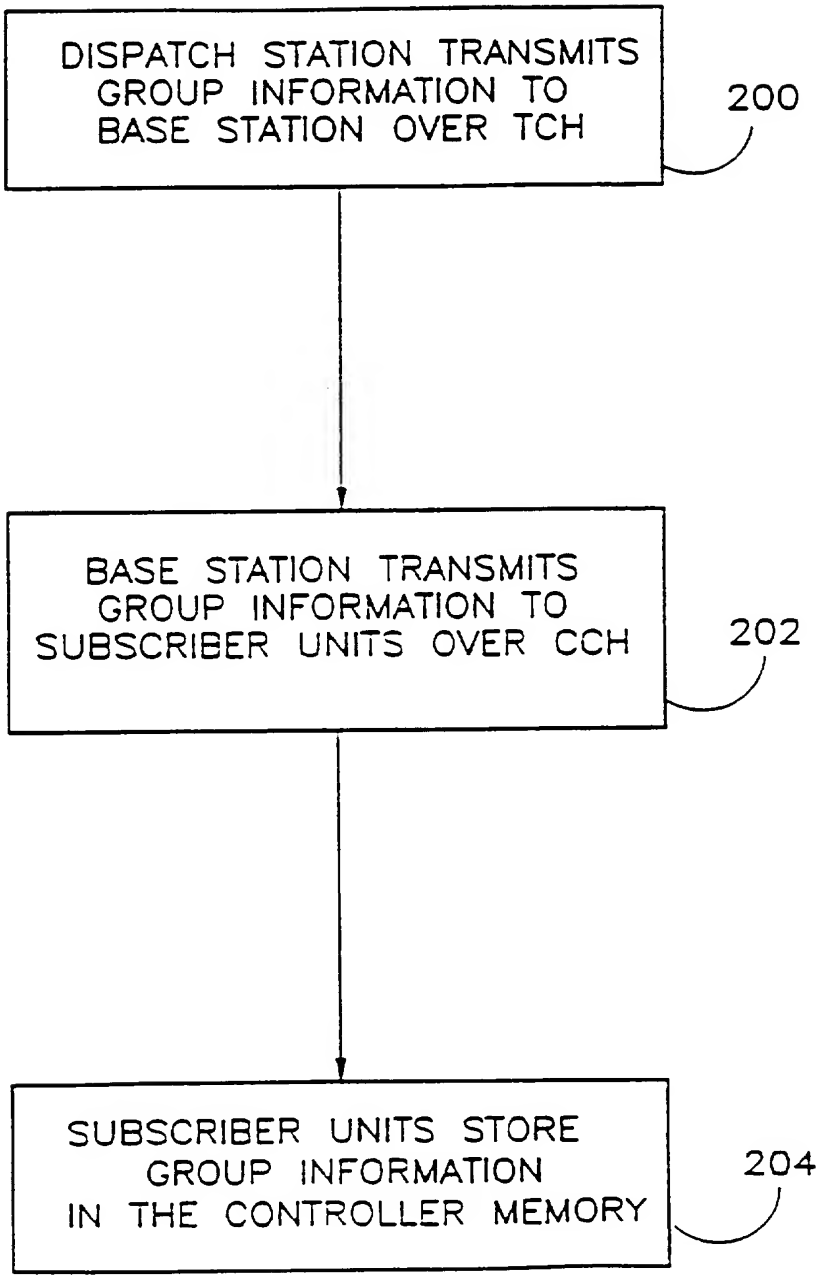

DISPATCH STATION TRANSMITS GROUP INFORMATION TO BASE STATION OVER TCH
200
BASE STATION TRANSMITS GROUP INFORMATION TO SUBSCRIBER UNITS OVER CCH
202
SUBSCRIBER UNITS STORE GROUP INFORMATION IN THE CONTROLLER MEMORY
204

FIG. 9

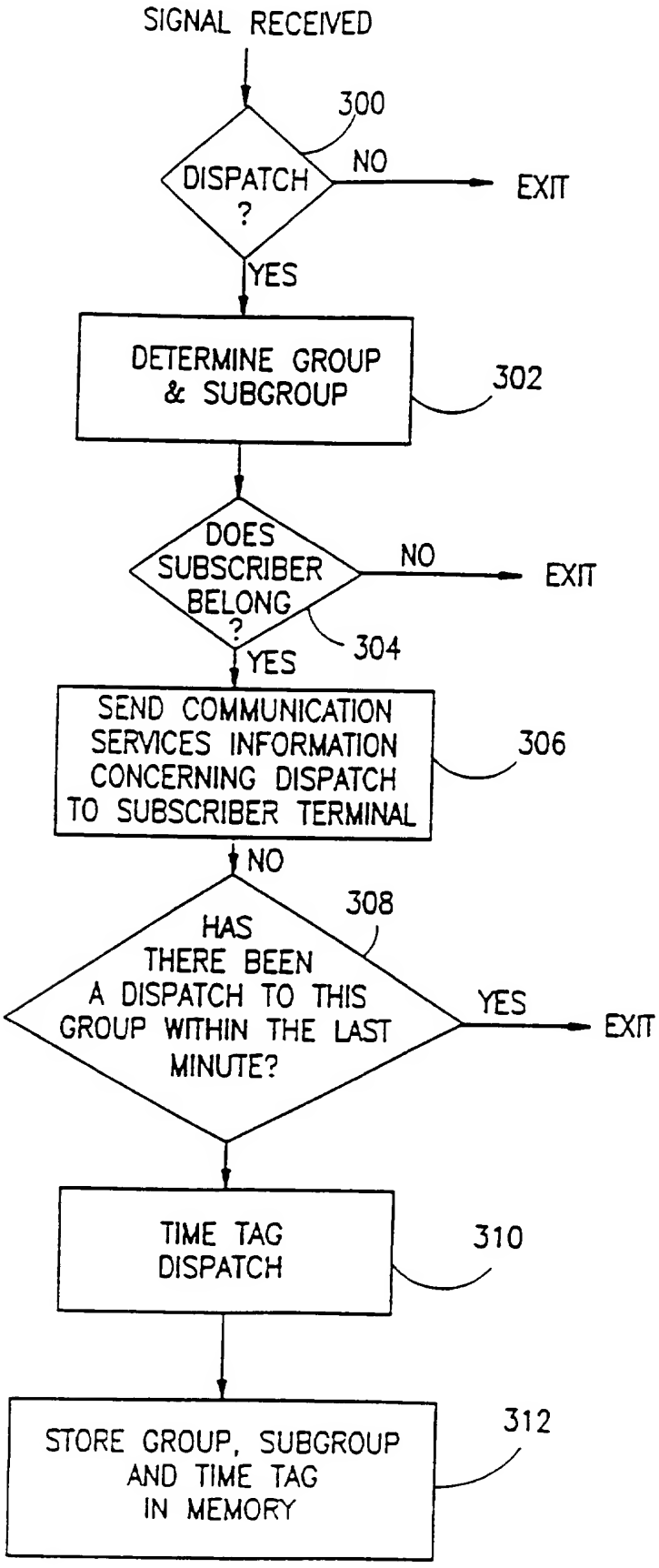

SIGNAL RECEIVED
300
DISPATCH ?
NO
EXIT
YES
DETERMINE GROUP & SUBGROUP
302
DOES SUBSCRIBER BELONG ?
NO
EXIT
304
YES
SEND COMMUNICATION SERVICES INFORMATION CONCERNING DISPATCH TO SUBSCRIBER TERMINAL
306
NO
308
HAS THERE BEEN A DISPATCH TO THIS GROUP WITHIN THE LAST MINUTE?
YES
EXIT
TIME TAG DISPATCH
310
STORE GROUP, SUBGROUP AND TIME TAG IN MEMORY
312

FIG. 11

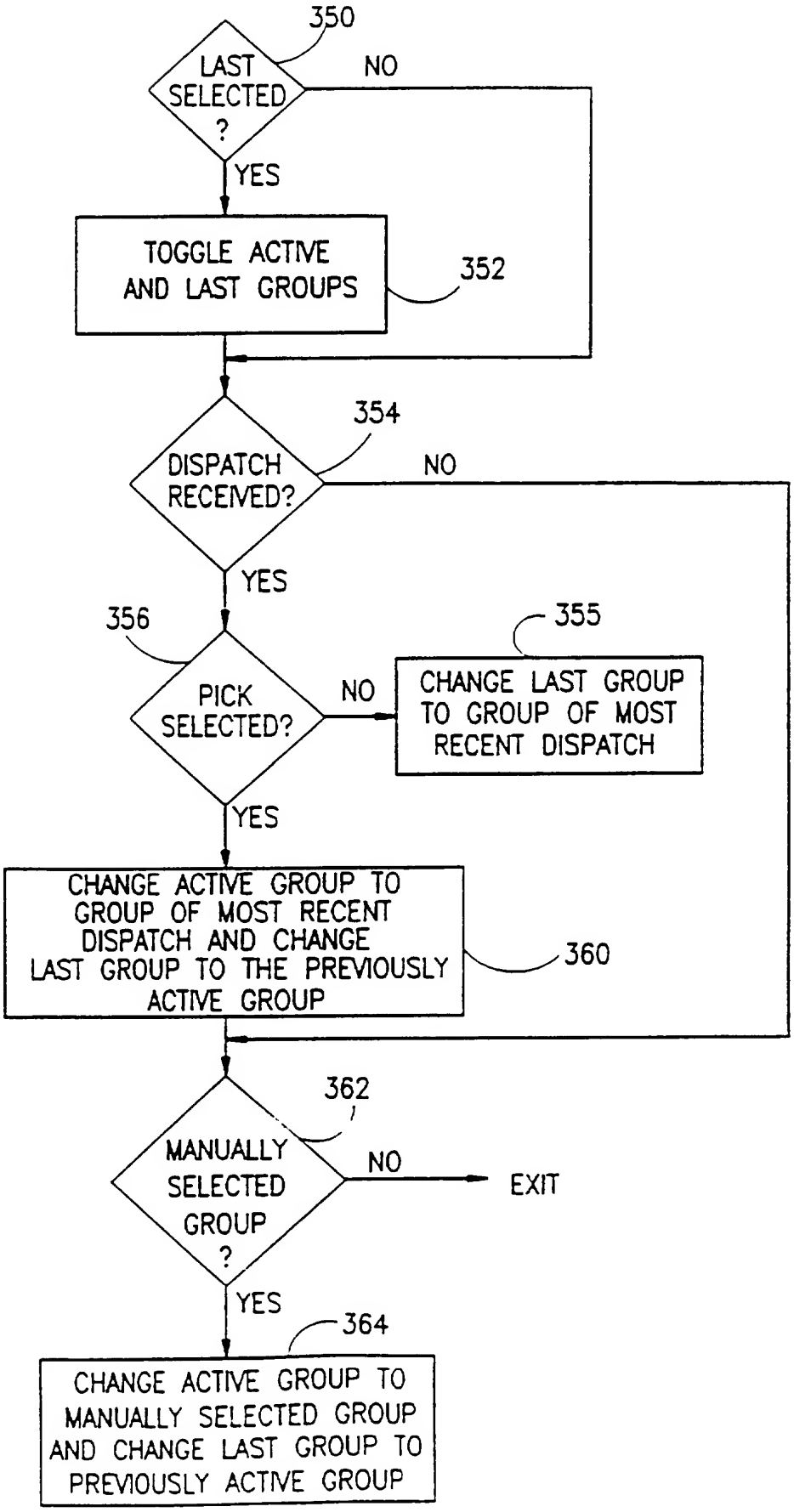
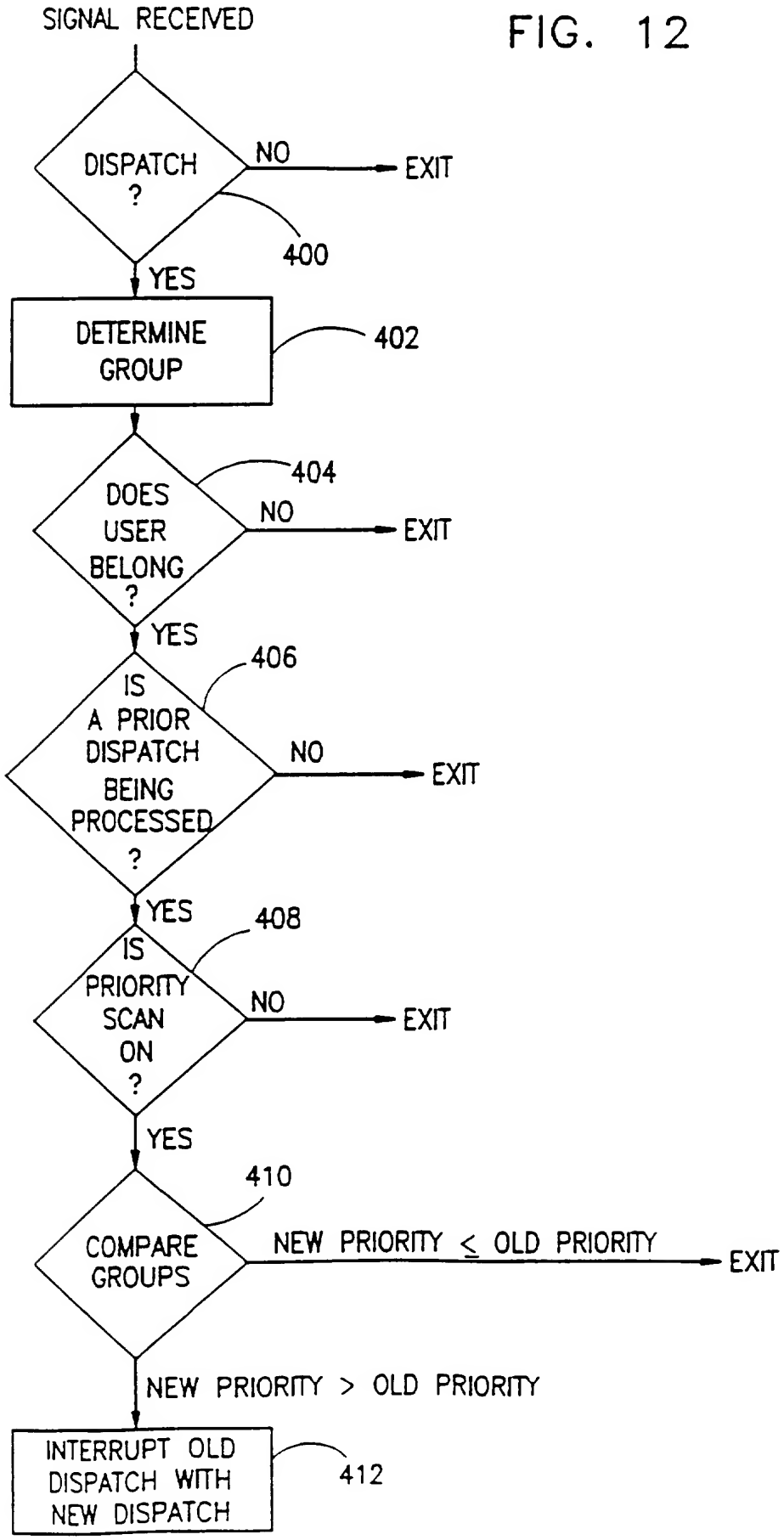

350
LAST SELECTED ?
NO
YES
TOGGLE ACTIVE AND LAST GROUPS
352
354
DISPATCH RECEIVED?
NO
YES
356
355
PICK SELECTED?
NO
CHANGE LAST GROUP TO GROUP OF MOST RECENT DISPATCH
YES
CHANGE ACTIVE GROUP TO GROUP OF MOST RECENT DISPATCH AND CHANGE LAST GROUP TO THE PREVIOUSLY ACTIVE GROUP
360
362
MANUALLY SELECTED GROUP ?
NO
EXIT
YES
364
CHANGE ACTIVE GROUP TO MANUALLY SELECTED GROUP AND CHANGE LAST GROUP TO PREVIOUSLY ACTIVE GROUP

FIG. 12


SIGNAL RECEIVED
DISPATCH ?
NO
EXIT
400
YES
DETERMINE GROUP
402
DOES USER BELONG ?
404
NO
EXIT
YES
IS A PRIOR DISPATCH BEING PROCESSED ?
406
NO
EXIT
YES
IS PRIORITY SCAN ON ?
408
NO
EXIT
YES
COMPARE GROUPS
410
NEW PRIORITY ≤ OLD PRIORITY
EXIT
NEW PRIORITY > OLD PRIORITY
INTERRUPT OLD DISPATCH WITH NEW DISPATCH
412

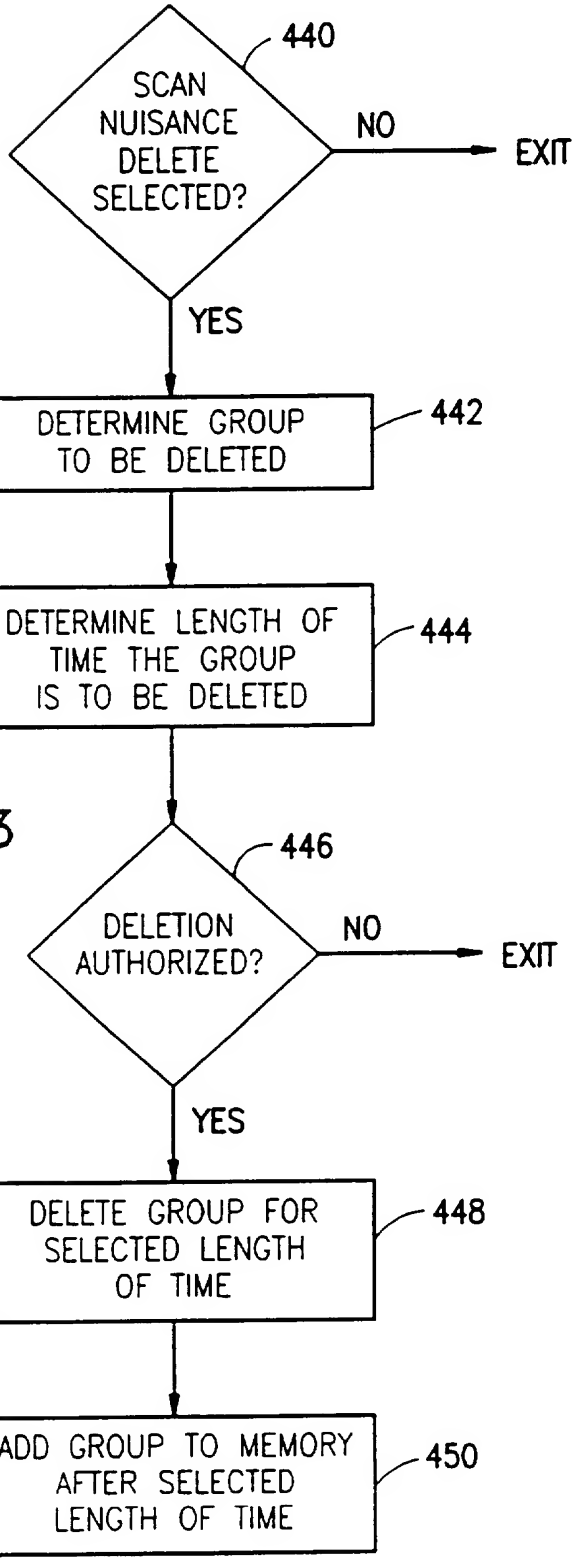
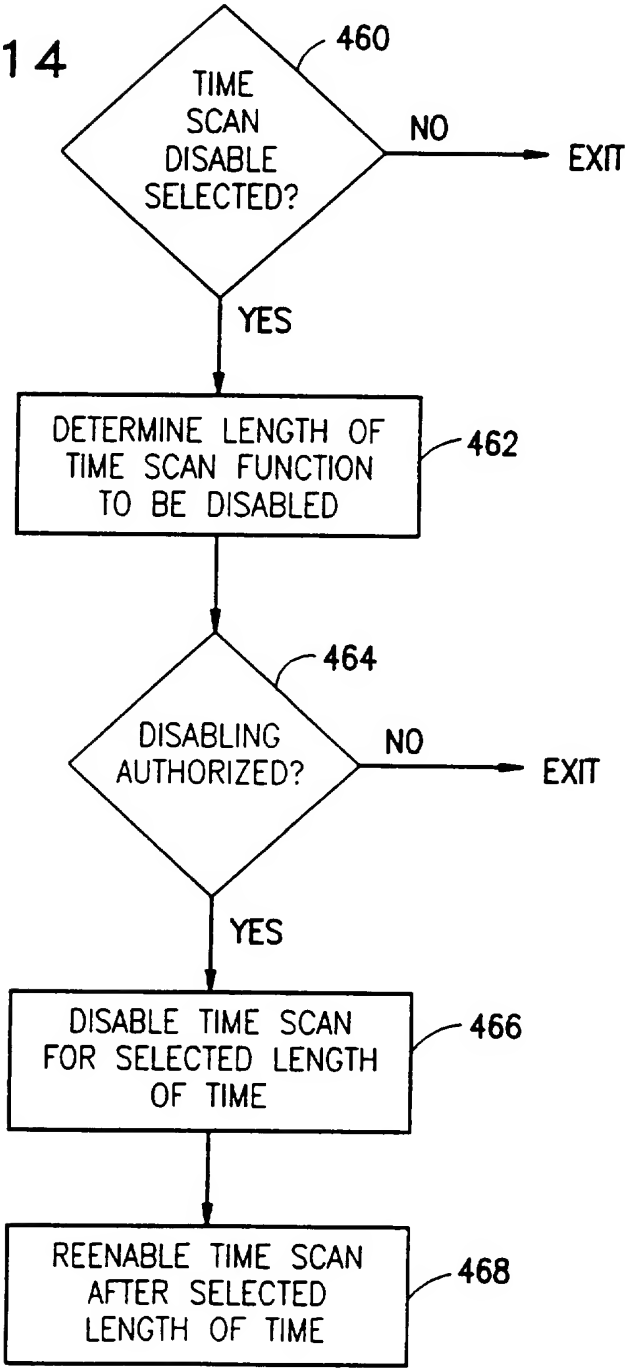

440
SCAN NUISANCE DELETE SELECTED?
NO
EXIT
YES
DETERMINE GROUP TO BE DELETED
442
DETERMINE LENGTH OF TIME THE GROUP IS TO BE DELETED
444
446
DELETION AUTHORIZED?
NO
EXIT
YES
DELETE GROUP FOR SELECTED LENGTH OF TIME
448
ADD GROUP TO MEMORY AFTER SELECTED LENGTH OF TIME
450

FIG. 13

FIG. 14


460
TIME SCAN DISABLE SELECTED?
NO
EXIT
YES
DETERMINE LENGTH OF TIME SCAN FUNCTION TO BE DISABLED
462
464
DISABLING AUTHORIZED?
NO
EXIT
YES
DISABLE TIME SCAN FOR SELECTED LENGTH OF TIME
466
REENABLE TIME SCAN AFTER SELECTED LENGTH OF TIME
468

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03187

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :H04B 7/00
US CL : 455/166.2, 54.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/166.2, 161.1, 179.1, 181.1, 184.1, 185.1, 186.1, 89, 54.1, 54.2, 34.2, 33.1; 379/59

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US, A, 5,448,750 (ERIKSSON ET AL) 05 SEPTEMBER 1995, SEE FIGS. 2a-2b AND 3.	1-10
Y	US, A, 5,263,176 (KOJIMA ET AL) 16 NOVEMBER 1993, SEE FIG. 4.	1-10
Y	US, A, 5,214,790 (KOZLOWSKI ET AL) 25 MAY 1993, SEE FIGS. 2A-2B.	1-10
Y	US, A, 5,235,631 (GRUBE ET AL) 10 AUGUST 1993, SEE FIGS. 2-4.	1-10
Y	US, A, 5,077,828 (WALDROUP) 31 DECEMBER 1991, SEE FIGS. 1-9.	1-10
Y,P	US, A, 5,437,053 (SAWA ET AL) 25 JULY 1995, SEE FIGS. 7-17.	11-34

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 10 JUNE 1996	Date of mailing of the international search report 17 JUL 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer DORIS TO B. Hardwick for Telephone No. (703) 305-4827

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03187

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US, A, 5,471,646 (SCHULTZ) 28 NOVEMBER 1995, SEE FIGS. 1-6.	11-34
A,P	US, A, 5,465,388 (ZICKER) 07 NOVEMBER 1995, SEE FIGS. 8.	11-34
A	US, A, 5,371,900 (BAR-ON ET AL) 06 DECEMBER 1994, SEE FIGS. 1-5.	11-34
A,P	US, A, 5,423,061 (FUMAROLO ET AL) 06 JULY 1995, SEE FIGS. 1-3.	11-34
A	US, A, 5,381,346 (MONAHAN-MITCHELL ET AL) 10 JANUARY 1995, SEE FIG. 2.	1-10
Y,P	US, A, 5,483,672 (SASUTA) 09 JANUARY 1996, SEE FIGS. 1-2.	1-10